Blood Pressure Self-Monitoring

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With many chronic diseases, it's common practice for patients to monitor vital clinical data. Should patients with hypertension follow suit?

Hypertension is one of the most common diseases facing primary care providers today and a prominent risk factor for cardiovascular disease in the United States. Although treatment guidelines for hypertension have been developed and research continues to support the benefits of treating elevated blood pressure, mortality and morbidity secondary to hypertension remain high.[1,2] One reason for the bleak picture may be the failure of clinicians to promote patient monitoring of blood pressure.

Patient monitoring of vital clinical data is common practice in the management of such chronic diseases as diabetes and congestive heart failure but notably uncommon in the management of hypertension. Although self-monitoring equipment for blood pressure measurement is readily available to most Americans, its potential use in the care of patients with hypertension has been insufficiently illuminated for most providers. Patient blood pressure monitoring can help clinicians base treatment decisions on more accurate data, can improve blood pressure control by allowing for timely adjustment of antihypertensive medications, and can improve outcomes related to chronic heart failure and type 2 diabetes.

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This article briefly defines hypertension—including both "white coat" and masked hypertension—and discusses the research comparing home- and office-based blood pressure measurements in terms of accuracy and clinical outcomes. It also suggests ways to use these research findings to promote evidenced-based clinical practice.

DIAGNOSING HYPERTENSION

Hypertension isn't always a clear cut diagnosis in the clinical setting. The target blood pressure values as recommended in the *Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of Hypertension (JNC 7)* identify target blood pressures of less than 140/90 mm Hg in patients without renal disease or diabetes and less than 130/80 mm Hg in patients with diabetes or renal disease.[1,2] Most practitioners believe that diagnosis and treatment of hypertension should be based on more than a single elevated reading, but in a clinical setting, blood pressure measurements may not accurately reflect arterial blood pressure over a 24-hour period, causing hypertension to be either overlooked or misdiagnosed.

So-called white coat hypertension is a temporary elevation in a patient's blood pressure that occurs only when his or her blood pressure is measured in a clinical setting, usually as a result of patient anxiety. When checked at home or in another setting, the patient's blood pressure values are normal. White coat hypertension has a relatively benign outcome compared to sustained, mild hypertension.[3,4] Failure to recognize white coat hypertension, however, can lead to the inappropriate use of antihypertensive medications.[3]

Dolen and colleagues reviewed the clinical data of 5,716 patients over a 22-year period and, on this basis, concluded that the overall prevalence of white coat hypertension was about 15%. Analysis confirmed that older adults, females, and nonsmokers had a higher prevalence of white coat hypertension.[3]

A study published in 2005 by Verdecchia and colleagues pooled data from four prospective cohort studies completed in the United States, Japan, and Italy, conducting the first known study to investigate the short- and long-term risk for stroke, ambulatory hypertension, and clinical normotension in subjects with white coat hypertension in a multinational and multiethnic population.[5] The crude stroke rate (multiplied by 100 person years) was 0.35 in the normotensive group, 0.59 in the white coat hypertensive group, and 0.65 in the ambulatory hypertension group. The results showed a trend that suggested an increased incidence of stroke toward the end of a six-year period in the patients with white coat hypertension. This increased

incidence tended to equal the incidence of stroke in the normotensive group after nine years. Although this corresponded to a small number of events, it demonstrates a need for further long-term study of the effects of white coat hypertension on cardiovascular disease.

Masked hypertension is the inverse of white coat hypertension. Defined as a clinic blood pressure less than 140/90 mm Hg, but an elevated ambulatory blood pressure of greater than 135/85 mm Hg, studies have shown this to be a rather significant cardiac risk factor.[6,7] Characteristics influencing the risk of masked hypertension include younger age, male gender, family history of hypertension, smoking, alcohol use, hormonal contraceptive use, lack of exercise, stress reaction, and elevated blood pressure response to standing.[8]

TYPES OF BLOOD PRESSURE MONITORS

Blood pressure can be monitored at the health care provider's office or clinic, in the home by the patient, or with an ambulatory blood pressure monitor (ABPM). An ABPM is a noninvasive device used to measure blood pressure over a 24-hour period. The device consists of a portable sphygmomanometer attached to a recording device. The monitor is placed on and removed from the patient by a certified technician. The monitor is set to inflate and measure blood pressure every 30 minutes or less while the patient performs his or her normal daily activities.[9–11] Medicare reimbursement is available for ABPM when indicated to diagnose white coat hypertension.[10]

The gold standard of blood pressure measurement in the clinic is the classic mercury manometer, but because of environmental concerns regarding the use of mercury it is no longer commonly used in the clinic setting.[9,12,13] The use of aneroid manometers with a stethoscope is still widespread. Blood pressure devices either use an ausculatory method, requiring the clinician to listen for blood flow through a stethoscope to determine the measurement, or an oscillometric method, which uses small fluctuations in cuff pressure to identify the systolic, mean, and diastolic processes.[9,12]

Home blood pressure monitors that use both the ausculatory and oscillometric methods can be purchased at many retail stores. Automated monitors that use the oscillometric method of obtaining blood pressure readings can measure blood pressure on the upper arm, wrist, or finger.[9,10,12]

DETERMINING THE ACCURACY OF READINGS

When readings from home blood pressure monitoring are considered, the monitor itself needs to be validated for reliability and adjustments need to be made for human error.[9,11,12] There are currently two published standards for determining the accuracy of blood pressure monitors independent of the manufacturer's claims. In the United States, the FDA accepts the standard of the Association for the Advancement of Medical Instrumentation. In Europe, the more comprehensive protocol of the British Hypertensive Society is used.[9,10,12]

Before accuracy standards existed, most home blood pressure monitors were considered inaccurate. Studies have shown that fully automated oscillometric devices and calibrated aneroid sphygmomanometers are equally reliable in predicting average daytime blood pressure.[14] Home blood pressure monitors have been shown to have reproducible readings with a standard deviation of less than 3.1 mm Hg for both systolic and diastolic measurements when an artificial oscillometric simulator is used to eliminate human error.[12]

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Devices that monitor the blood pressure on a finger are not considered accurate. Distortions in readings can be caused by peripheral vasoconstriction and positioning of the extremity.[9] The wrist monitors are considered to be more accurate than the finger models but are very dependent on the position of the device when compared with the heart level.[9,12] Monitors that measure blood pressure on the arm tend to be the most accurate, though there are several factors that affect their accuracy, such as the fit of the cuff on the arm, placement of the cuff over the brachial artery, support of the arm, and positioning of the arm.[9–12]

Using a cuff that is too small for the patient can result in an 8 mm Hg lower systolic reading and an 8 mm Hg higher diastolic reading.[11] In monitors that use oscillometric

technology, incorrect placement of the cuff may result in an inaccurate reading. Failure to support the arm can result in a 2 mm Hg false higher reading in both systolic and diastolic readings.[11] When an upper arm cuff is used to measure blood pressure in a person who is standing, both systolic and diastolic readings can be 8 mm Hg higher if the arm is positioned by the side rather than at heart level.[12] Although occasional differences in blood pressure of less than 5 mm Hg are seldom considered clinically significant, a combination of these factors could cause a serious error that resulted in inadequate or over treatment of hypertension.

The validity and reliability of blood pressure readings are important considerations not only for home blood pressure monitoring but also for the monitoring done in a clinical setting by health care workers. Errors of up to 6 mm Hg for systolic and 10 mm Hg for diastolic in office blood pressure readings have been recorded when correct technique was not used to take the measurements.[12]

Factors contributing to human error in using the ausculatory method include background noise, failure to place the stethoscope over the brachial artery, inability to see the numbers accurately on the aneroid manometer, failure to have the aneroid monitor calibrated at regular intervals, inadequate hearing acuity, too rapid deflation of the cuff, and inaccurate recording of the readings.[11,12] Automated blood pressure monitors that use the oscillometric method give inaccurate readings in patients with cardiac arrythmias, such as atrial fibrillation in which there is a rapid ventricular response.[9,12] Observer bias also can affect the accuracy of the blood pressure readings. If the health care provider speaks to the patient or questions them before or during the measurement, the validity of the reading may be altered.[13]

Automated stationary blood pressure monitors found in pharmacy and retail stores generally are considered unreliable. More research into the accuracy of these machines is needed.[12] People who use these machines regularly tend to believe they are accurate and frequently make health care decisions based on the information they provide.[15] Health care providers need to determine the type of blood pressure monitor patients are using and evaluate their potential for inaccuracy before suggesting any changes in treatment. Although they are often inaccurate, these machines do increase public awareness of hypertension and the importance of hypertension screening.

HOME MONITORING AND CLINICAL OUTCOMES

Research into the effect of home blood pressure monitoring on a variety of chronic illnesses has provided mixed results. The effect of blood pressure control on the progression to left ventricular hypertrophy as evidenced by electrocardiography (ECG) was studied over a nine-year period in 50 subjects. The ECG changes correlated better with the home blood pressure average measurements than with the office measurements.[16] In one study, 121 adults with essential hypertension were randomly assigned to receive either home blood pressure monitoring or usual care in accordance with guidelines of the Joint National Committee on Prevention, Detection, and Treatment of High Blood Pressure.[17] Mean arterial pressure decreased by 2.8 mm Hg in the group assigned to home monitoring and increased by 1.3 mm Hg in the group receiving usual care.[17] The investigators concluded that the reduction was due in part to the more frequent changes in the type and dose of antihypertensive medication. Using telecommunication to transfer blood pressure readings directly to the health care provider, as was done in this study, ensures that results are reported accurately. When patients are asked to self-record their blood pressure, they tend not to report the higher readings.[18]

A study of 60 patients with heart failure was conducted using physiologic home management. Measurements of weight, blood pressure, oxygen saturation, and heart rate were taken several times daily and transmitted to the study coordinator for evaluation and treatment changes. Subject's hospital admissions, lengths of stay, and hospital charges were reduced significantly when compared to prestudy values. In addition, quality of life scores were significantly higher than baseline.[19]

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Finally, home blood pressure monitoring proved superior to clinic blood pressure monitoring in a study involving 55 patients with type 2 diabetes. The two methods were compared to 24-hour ambulatory blood

pressure monitoring.[20] Clinic blood pressure produced white coat hypertension in nearly one half of the patients, possibly causing providers to treat with antihypertensive drugs unnecessarily.

A major barrier to the widespread use of blood pressure self-monitoring in patients with hypertension may involve financial limitations. Patients may be unable to afford to purchase home blood pressure monitors and many health insurance companies do not reimburse for these items. More research is needed in the area of long-term cost reduction by secondary prevention of cardiovascular events versus the initial cost of monitoring equipment.

IMPLICATIONS FOR PRIMARY CARE PRACTICE

With the improved accuracy of home blood pressure monitoring equipment, it's clear that the use of such equipment can be beneficial in chronic disease management. There are, however, several obstacles that need to be addressed with patients before self-monitoring is used to make therapeutic changes. The patient needs to be educated in the correct use of the monitor. This could be accomplished through the use of a videotape, a group class, or individual instruction by a nurse.

Instruction in the proper use of the monitor; the significance of target readings; what to do when the readings are consistently high or low; and the effects of such lifestyle modifications as nutrition, exercise, and healthy behaviors are essential to achieve success with a self-management program. The patient should be taught to record all readings, including extreme variations. Emphasis should be placed on using the readings to identify patterns and to recognize simple interventions that can be implemented when a single elevated reading occurs (for example, lying down to rest, breathing deeply, and avoiding caffeine). Patients also should be told to contact their health care provider when readings are consistently high and to bring their blood pressure monitoring equipment into the clinic to have it checked at every routine appointment.

There are several benefits to involving the patient in his or her health care. Self-management and therapeutic behavioral changes are necessary to achieve good control of any chronic disease. Home blood pressure monitors provide health care professionals with yet another tool to improve the quality of life and the health of their patients. ●

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